

DEPARTMENT OF MECHANICAL ENGINEERING

WILLIAM MAXWELL REED SEMINAR SERIES

“Unconventional Attitude and Formation Control Technology for Small-Satellite Swarms.”

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Abstract:

Small satellites are less expensive to build and launch than large spacecraft. Furthermore, multiple small satellites working cooperatively can often meet or exceed the operational capability of a single monolithic satellite. However, the control systems for large spacecraft are not always well suited to small satellites. For example, conventional flywheel-actuation systems are not ideal for small-scale applications because they require significant power, are subject to wear, and tend to be heavy. This seminar presents new small-satellite control technologies that are efficient, reliable, and can be powered by renewable energy sources.

One of these new technologies is a system for controlling a small satellite’s attitude. This unconventional method relies on a system of vibrating masses as opposed to the rotating wheels used for traditional attitude control. By appropriately vibrating the masses, it is possible to steer the satellite to any desired attitude, for example, pointing toward Earth or another planet. This new approach requires new feedback control algorithms because the actuators vibrate rather than rotate. A prototype of this attitude control system is currently being tested onboard the International Space Station.

This seminar will also present an electromagnetic formation flying method, where each small satellite in a swarm is equipped with electromagnetic coils, which can be energized to create forces between satellites. By appropriately energizing the coils, we can generate forces that drive the satellites into desired swarm formations. One key aspect of this work is the use of alternating magnetic field forces to decouple inter-satellite forces, and thus, enable swarms with many satellites.

Speaker Bio:

Jesse Hoagg is the Donald and Gertrude Lester Professor in the Department of Mechanical Engineering at the University of Kentucky. His research focuses on the development and application of control theory to diverse areas in science and engineering—ranging from formation control methods for autonomous vehicles to the study of human learning to new control approaches for aerospace vehicles. He is the author of 130 peer-reviewed publications. Prior to joining the University of Kentucky, he was a postdoctoral research fellow at the University of Michigan from 2009 to 2010. He worked for the consulting firm McKinsey & Company from 2006 to 2009. He received the Ph.D. degree in aerospace engineering from the University of Michigan in 2006. He also received an M.S. in mathematics and an M.S.E. in aerospace engineering from the University of Michigan, and a B.S.E. in civil and environmental engineering from Duke University.

Date: Friday, April 22, 2022

Place: Whitehall Classroom Building 110

Time: 3:00 PM EST

Contact: Dr. Alexandre Martin 257-4462

Attendance open to all interested persons